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PHOTOGRAPHIC INTERPRETATION REPORT

CHRONOLOGICAL DEVELOPMENT OF THE ZAGORSK LIQUID ROCKET ENGINE TEST FACILITY KRASNOZAVODSK, USSR

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DECEMBER 1967
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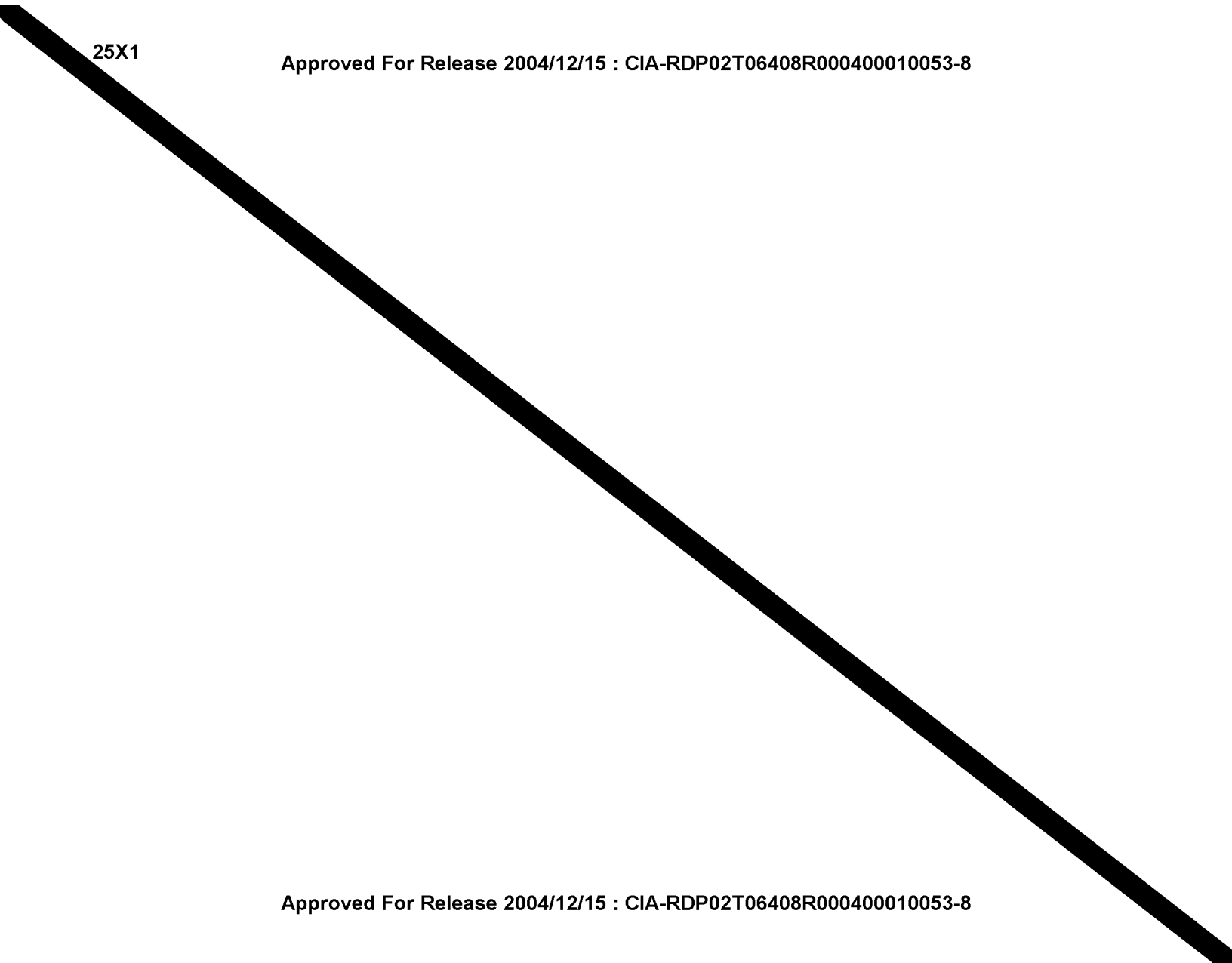

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PHOTOGRAPHIC INTERPRETATION REPORT

CHRONOLOGICAL DEVELOPMENT OF THE ZAGORSK LIQUID ROCKET ENGINE TEST FACILITY KRASNOZAVODSK, USSR

DECEMBER 1967

NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER

SUMMARY

The Zagorsk Liquid Rocket Engine Test Facility Krasnozavodsk is the largest such installation in the USSR. The facility includes 5 vertical and 4 horizontal test positions. Four of the vertical test positions were present when the installation was first observed [redacted] Since then the facility has approximately doubled in size and now includes a probable liquid hydrogen plant and a new test area probably designed to test upper-stage rocket engines.

INTRODUCTION

This report is concerned primarily with the chronological development of a liquid rocket engine test facility near Zagorsk, USSR. Also included in this report are detailed descriptions and illustrations of several of the more significant structures in the facility and of a new test area under construction.

The Zagorsk Liquid Rocket Engine Test Facility Krasnozavodsk [redacted] is located at 56-25N 038-10E, about 6 nautical miles (nm) north-northeast of Zagorsk and 44 nm northeast of Moskva (Figure 1). This installation is the largest rocket engine test facility in the USSR, comprising a double-fenced area covering approximately 1.5 square nm and additional unsecured support and housing areas, covering about 0.5 square nm (Figures 2,3 and 4).

The chronological data and other information presented in this report have been derived from 37 photographic missions that have covered the Zagorsk installation during a time period extending from [redacted] A study of all the photography covering the facility has made possible a compilation of the construction chronology and has also resulted in interpretations of the functions of most of the structures. This chronological and functional information along with mensural data is summarized in Table 1. Highlights of the construction chronology are presented in narrative form in the first part of this report, and a line drawing of the layout of the installation (Figure 4) is color coded to illustrate the sequence of construction. The numbered items of Table 1 are keyed to the items shown on the layout of the facility (Figure 4). In many cases the determination of starting and completion dates of specific items are judgments based on an intermittent flow of photographic data. While photographic coverage of the facility has been relatively frequent, the photography has often been of poor interpretability and of small scale, particularly during the period [redacted] These factors account for items reported as first observed and completed on the same date. On the photography of relatively poor interpretability, it has not been possible to determine with certainity whether or not any structure is complete, let alone operational.

Descriptions and illustrations of several of the more significant test stands and of a new test area under construction follow the chronological portion of this report. The Zagorsk installation occupies rolling wooded terrain dissected by ravines or gullies which range generally from northeast to southwest. The sites of the 5 vertical and 4 horizontal test positions of the facility were obviously selected to take advantage of the topography in that the test stands were all built in the same general vicinity along the edge of a steep cliff or bluff which extends irregularly along the northern side of the installation (Figure 4). Utilization of this bluff would serve to simplify building problems such as the positioning of flame deflectors, and locating the stands near each other would also tend to simplify certain operational problems such as the storage and disposal of coolant water for the deflectors. [redacted]

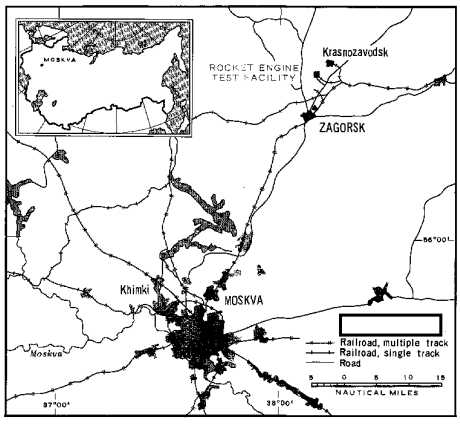

FIGURE 1. LOCATION MAP.

No attempt is made in this report to describe housing, maintenance, supply, and storage areas which are located outside the southern and southeastern edges of the secured portions of the facility (Figures 3 and 4).

HIGHLIGHTS OF CONSTRUCTION CHRONOLOGY

1942 - 1961

The Zagorsk Rocket Engine Test Facility was not present on [redacted] photography of the site. It was first observed on [redacted] Although the area in general can be identified on the [redacted] photography, the interpretability of the photography does not permit a description of the construction status of the various buildings at that time.

1962

The first usable [redacted] photography of the installation was obtained in [redacted] Test Stands No 1, No 2, and No 3 (annotated on Figure 4) were present at that time as well as their associated assembly and checkout buildings. The air liquefaction plant (item 66, Figure 4) and numerous support buildings were also observed. Subsequent photographic

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FIGURE 2. ZAGORSK LIQUID ROCKET ENGINE TEST FACILITY KRASNOZAVODSK AND SURROUNDING AREA. [redacted]

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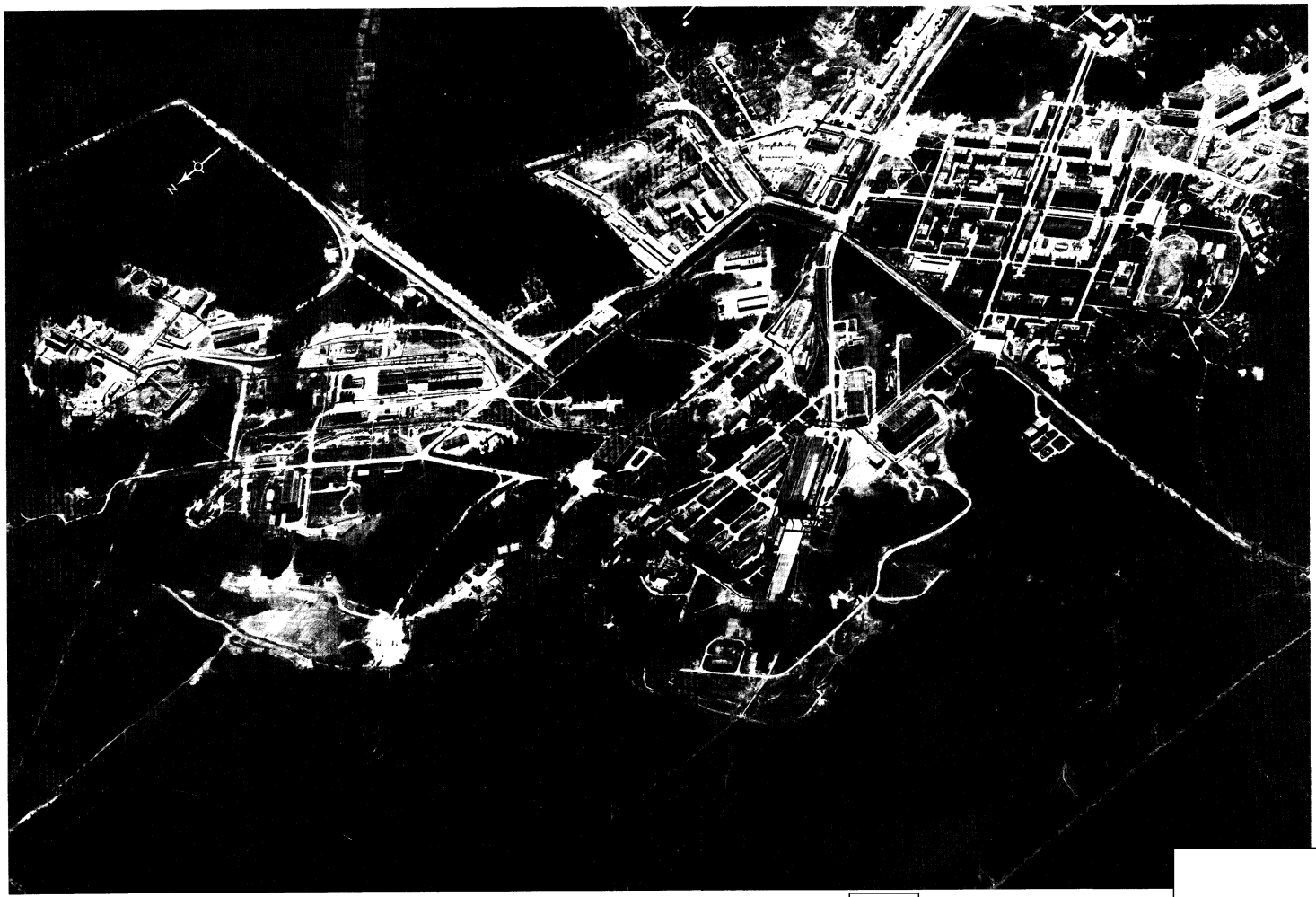


FIGURE 3. ZAGORSK LIQUID ROCKET ENGINE TEST FACILITY KRASNOZAVODSK

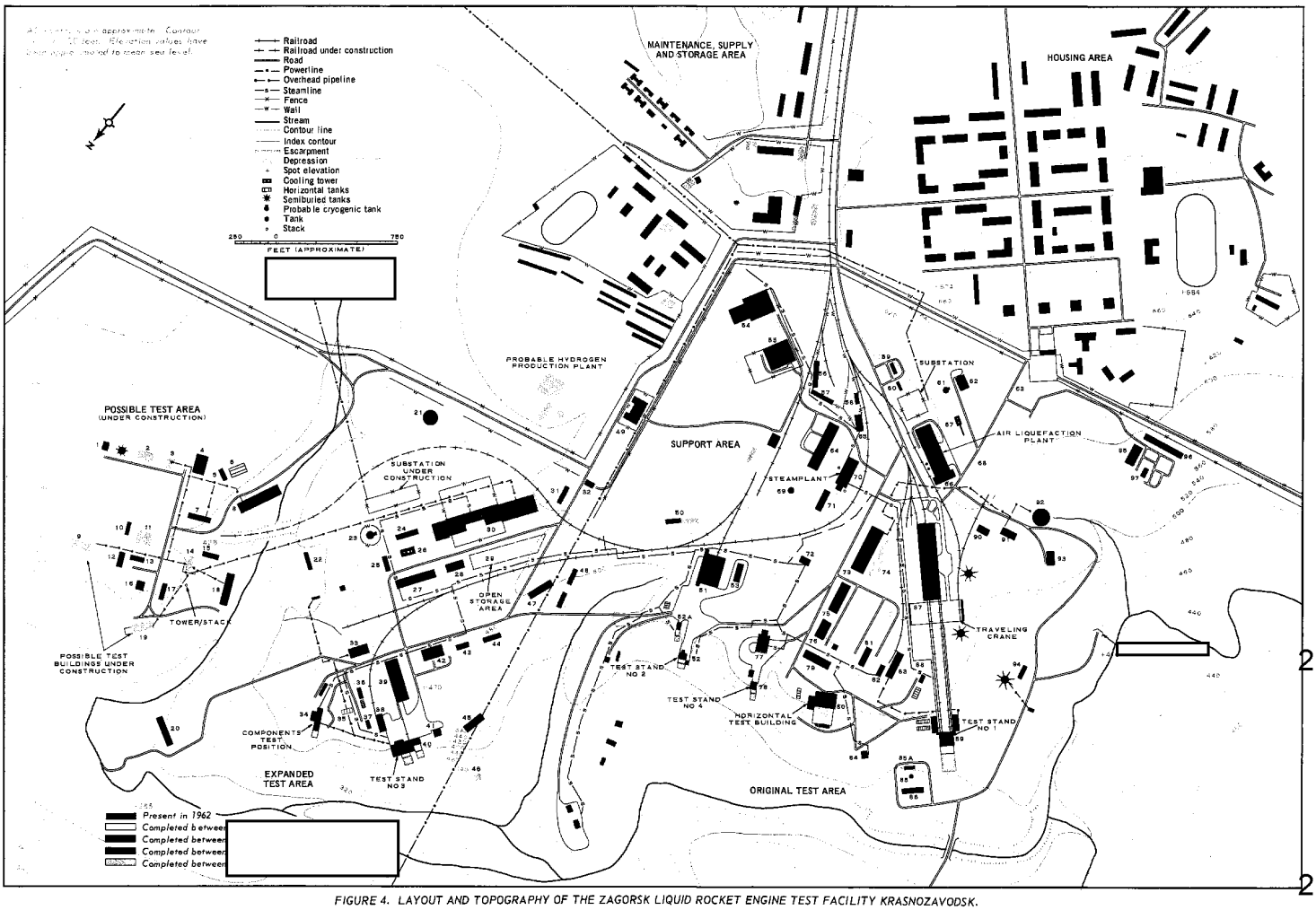


FIGURE 4. LAYOUT AND TOPOGRAPHY OF THE ZAGORSK LIQUID ROCKET ENGINE TEST FACILITY KRASNOZAVODSK.

Table 1. Functions, Dimensions, and Construction Chronology of Structures in the Zagorsk Rocket Engine Test Facility Krasnozavodsk (Item numbers are keyed to Figure 4)

Item	Function	Explanatory Notes
1	Test support	
2	Poss test	Poss cold flow test bldg u/c
3	Support	
4	Checkout	
5	Pumphouse/boilerhouse	Associated with item 6
6	Pressure tanks/steam accumulators	Contains an approx volumetric capacity of 2,700 cu ft
7	Storage	
8	Assembly/checkout	
9	Horizontal test	Components/propellent test bldg u/c; may have an altitude simulation capability in the future
10	Support	
11	Propellant handling	Contains multiple roof vents
12	Tankage control	
13	Vertical pressure tanks	Contains 16 vertical tanks prob containing nitrogen or helium gas
14	Propellant storage	Contains 5 spherical tanks, each [redacted] approx capacity 330,000 gal
15	Pumphouse	
16	Test support	
17	Test support	Components test bldg
18	Support	
19	Horizontal test	U/C
20	Support	
21	Gasholder	Approx capacity 370,000 cu ft
22	Test support	
23	Tank	Cryogenic storage; approx capacity 400,000 gal or 54,000 cu ft
24	Support	
25	Support	
26	Forced-draft cooling tower	A 3-column unit associated with item 30
27	Support	
28	Support	
29	Open storage area	Part of area in evidence in [redacted]
30	Prob Hydrogen Production Plant	Central section complete by [redacted]
31	Support	Poor interpretability precludes mensuration
32	Security	
33	Test support	
34	Test position	Apparently used for components testing
35	Horizontal tanks	Roof cover represents area of tank array
36	Storage	
37	Test support	
38	Test support	
39	Assembly/checkout	Supports item 40
40	Test Stand No 3	
41	Control	
42	Support	
43	Support	
44	Support	
45	Test support	
46	Support	
47	Support	
48	Support	
49	Admin	
50	Support	Part of bldg complete in [redacted]
51	Assembly/checkout	Supports items 52 and 52a
52	Test Stand No 2	Capable of stage testing
52A	Test Stand No 2, Position B	Prob tests single engines for Test Stand No 2
53	Component storage	
54	Fabrication	
55	Fabrication	
56	Storage	
57	Storage	
58	Storage	
59	Support	
60	Support	
61	Tank	Cryogenic storage tank
62	Admin	
63	Admin	Roof cover only approximate
64	Storage/warehouse	
65	Storage	
66	Air liquefaction plant	
67	Forced-draft & rack cooler	Forced-draft & rack cooling towers collocated to serve item 66
68	Vertical checkout/assembly	Supports vertical Test Stand No 1; low bays average [redacted] ft high
69	Tank	
70	Heating plant	
71	Support	
72	Support	
73	Support	Prob supports item 68
74	Storage	Poor interpretability precludes mensuration
75	Support	Prob supports item 68
76	Support	Prob supports item 68
77	Assembly/checkout	Serves item 78
78	Test Stand No 4	Small single-engine test position
79	Service	
80	Horizontal test	Located adjacent to associated control bldg, item 84
81	Service	
82	Service	
83	Service	
84	Control	Serves Test Stand No 1
85	Poss pumphouse	
85A	Tank	Poss propellant dump tank
86	Observation/support	
87	Assembly/checkout	Serves item 89; served by a large traveling crane; doubled in size between [redacted]
88	Service/checkout bldg	Prob houses test support equipment
89	Test Stand No 1	Both rail and road served
90	Storage	
91	Support	
92	Gasholder	Approx capacity 370,000 cu ft
93	Support	
94	Poss pumphouse	
95	Support	
96	Support	
97	Support	

*Greatest overall dimension of an irregularly shaped bldg; height is to highest bay.
**Complete when first observed unless otherwise noted.
Note: Dimensions are accurate within ±5 ft or 3 percent, whichever is greater, on all horizontal measurements and ±5 ft on all vertical measurements.

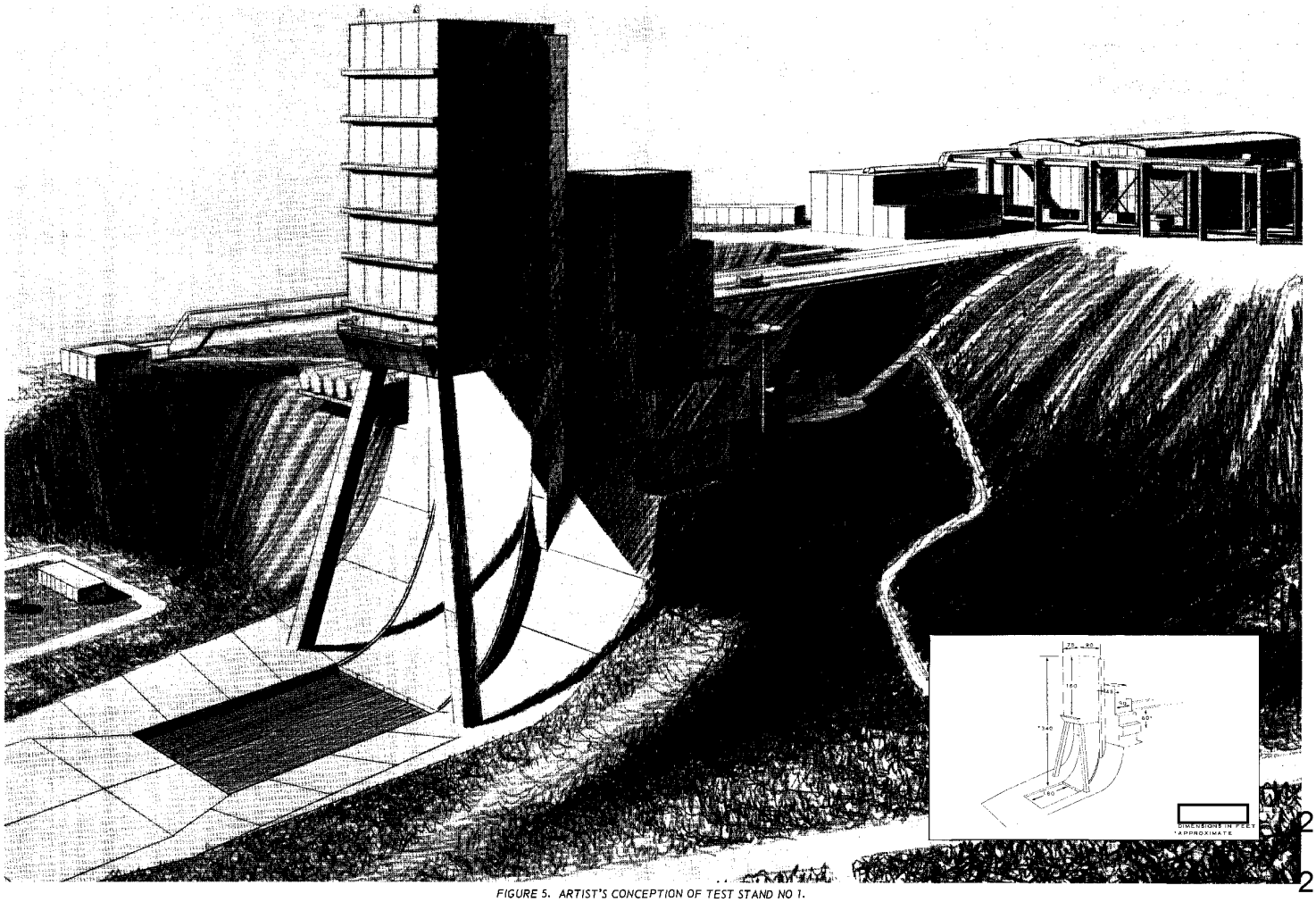
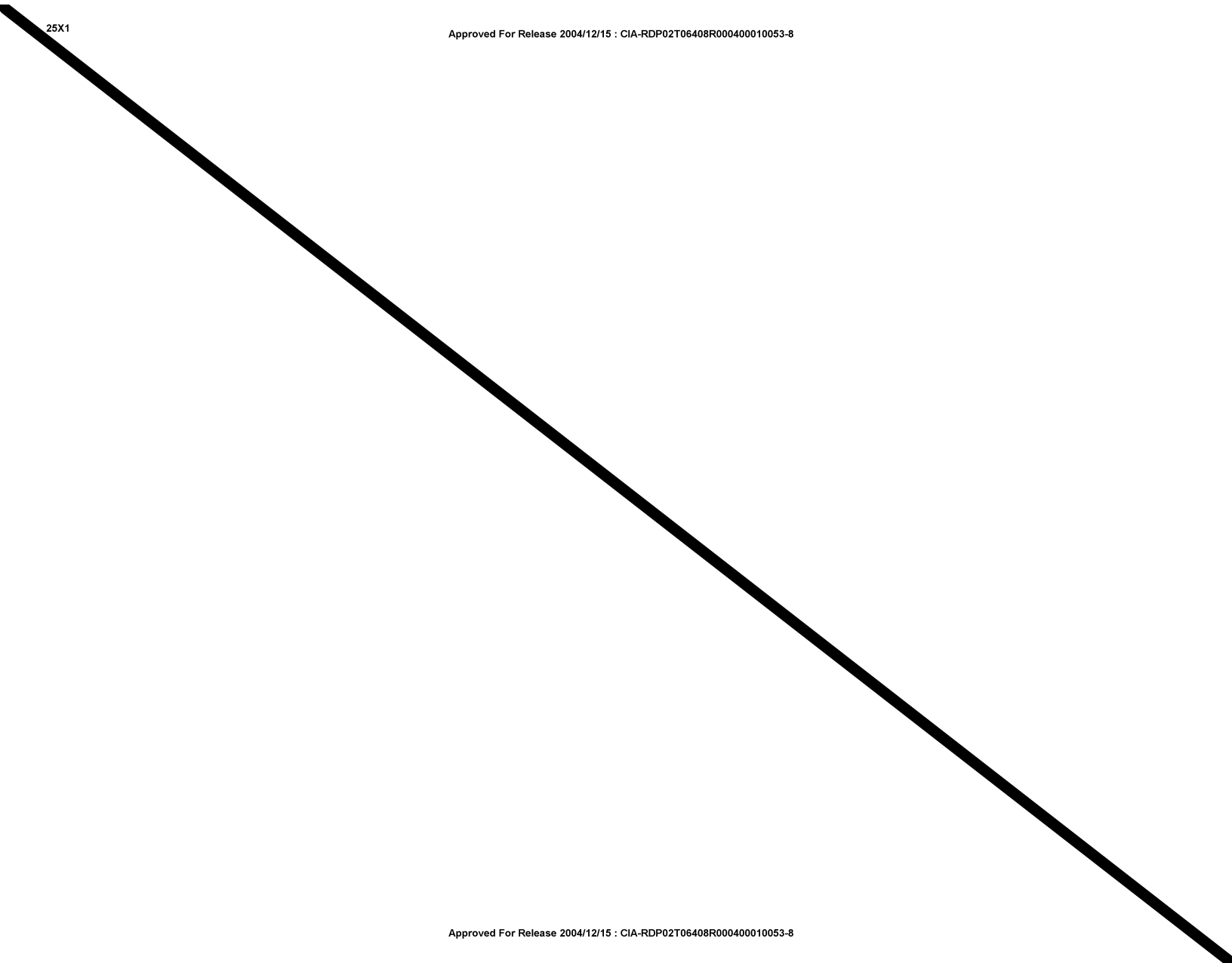


FIGURE 5. ARTIST'S CONCEPTION OF TEST STAND NO 1.



coverage in 1962 revealed that construction was continuing in the northeast portion of the facility.

1963 - 1964

25X1 Several significant construction items were completed during this time period. The large assembly/checkout building (item 87) serving Test Stand No 1, first observed in [redacted] was doubled in size by [redacted] and a large vertical assembly/checkout building (item 68) was completed by [redacted] A large multiposition horizontal test building (item 80), Test Stand No 4, and the components test stand (item 34) serving Test Stand No 3 were apparently complete by [redacted] Numerous test support and service buildings were also complete, including portions of the Probable Liquid Hydrogen Production Area.

1965 - 1966

Significant construction during this time period centered on expansion of the probable liquid hydrogen electrolysis building (item 30). The first large-scale photography of good interpretability was obtained in [redacted] and revealed the completion of numerous support and service buildings in a new test area at the northeast end of the facility. This coverage also permitted confirmation of the existence of steamlines, rail spurs, security fences, propellant lines, and numerous assorted types of tanks.

1967

The best photographic coverage of the facility to date was obtained in [redacted] This photography permitted a detailed functional analysis of several structures, previously seen in an early stage of construction. Two new horizontal test positions (items 9 and 19), both of which appeared to be in the late stages of construction, were confirmed for the first time, and several support and service buildings were observed to be complete.

DESCRIPTIONS OF SELECTED STRUCTURES

Table 1 provides an interpretation of the function of each significant structure of the Zagorsk test facility. The following items are considered to be of sufficient importance to warrant a more detailed discussion. Item numbers are keyed to Figure 4.

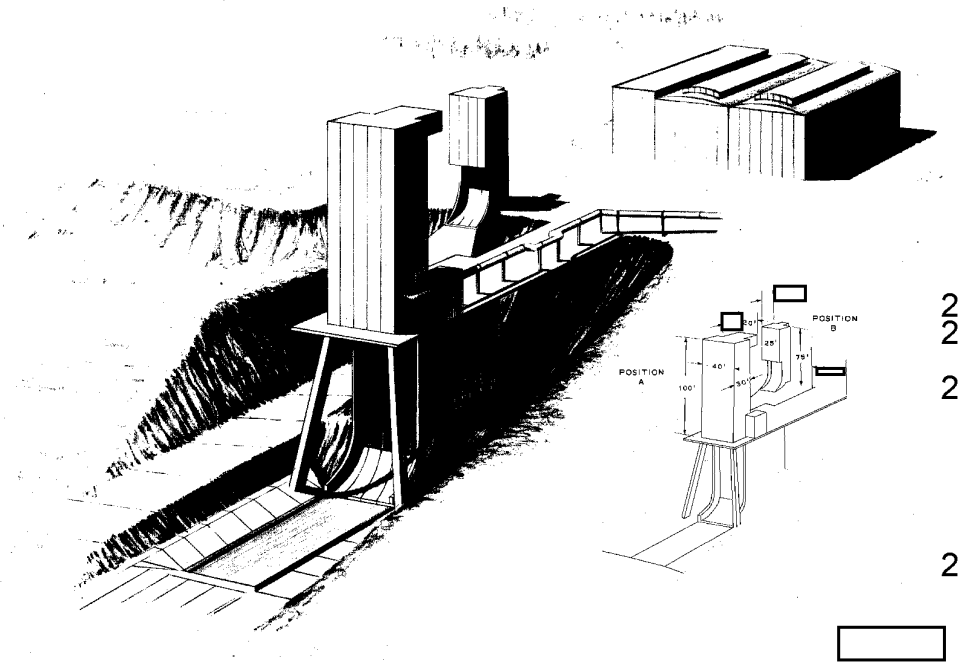


FIGURE 7. ARTIST'S CONCEPTION OF TEST STAND NO 2. (Dimensions of significant parts of Test Positions A and B are shown on the inset.)

TEST STAND NO 1

Test Stand No 1 (item 89) is the largest rocket engine test stand in the Soviet Union. An artist's conception and dimensions of this stand are presented on Figure 5. The stand is rail served and has a superstructure which rises 160 feet above the level of an access ramp 90 feet wide. The top of the stand is approximately 340 feet above the coolant sump. Its size and configuration would make this stand suitable for use in testing extremely large liquid propellant rocket engines - specifically, clusters of rocket engines and complete missile stages. In overall size it is larger than [redacted]

Assembly and checkout capabilities of Test Stand No 1 were increased during the period when the roof cover of the large assembly/checkout building (item 87) was doubled to its present dimensions. An additional service or checkout building (item 88) was also added at that time. Although small as compared with the large assembly/checkout building, this additional building is almost as large as the assembly/checkout buildings of other large rocket engine test facilities in the Soviet Union.

A third high-bay assembly/vertical checkout building (item 68) was completed in A large gasholder (item 92) with a capacity of 370,000 cubic feet is located adjacent to the northwest corner of this building. Located adjacent to the northeast corner of Test Stand No 1 is a control building (item 84) which is in a position that permits visual observation of static test firings by test facility personnel.

TEST STAND NO 2

Test Stand No 2 (items 52 and 52A) comprises 2 separate test positions. An artist's conception and dimensions of both test positions are presented in Figure 7. Test position A (item 52) is similar in configuration to Test Stand No 3 at the Pei-ching Guided Missile Development and Production Center, Chang-hsin-tien, China. 1/ It is apparently designed to static test liquid propellant rocket engines, and it also can probably accomodate entire missile stages. Test Position B (item 52A) may be designed to test single engines that will later be clustered and static tested at Test Position A. In any event, both stands are capable of testing liquid propellant rocket engines and utilize the same assembly/checkout building (item 51).

TEST STAND NO 3

Test Stand No 3 (item 40) is a large dual-position static test stand. An artist's conception and dimensions of this stand are presented on Figure 8. The size and configuration of Test Stand No 3 indicate that it is capable of static test firing liquid propellant rocket engines and entire missile stages. A nearby test position of unusual configuration (item 34) may function as a components test stand in support of Test Stand No 3. An artist's conception and dimensions of this test position are presented on Figure 9. A test posi-

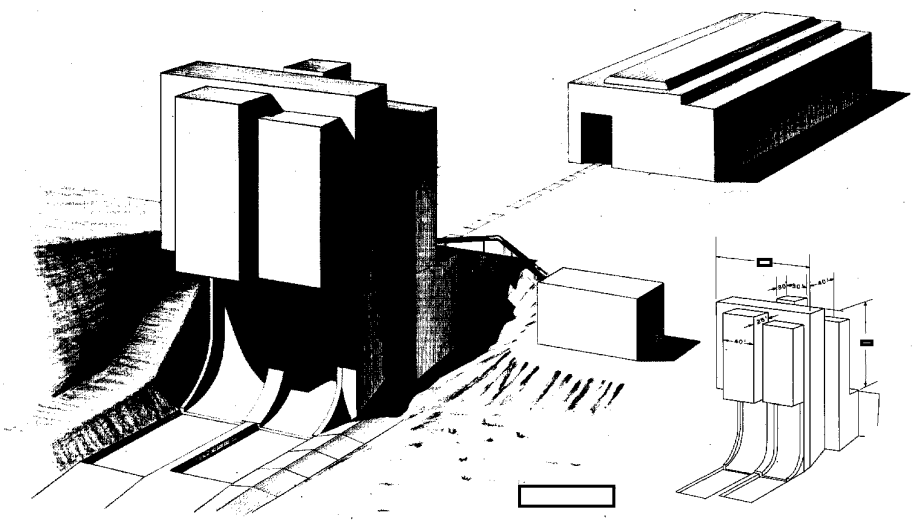


FIGURE 8. ARTIST'S CONCEPTION OF TEST STAND NO 3.

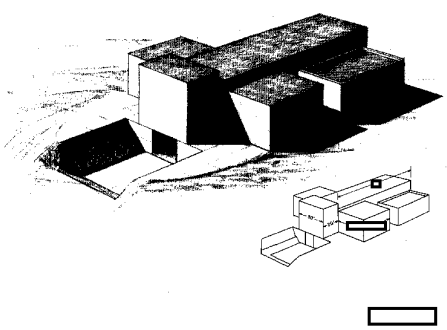


FIGURE 9. ARTIST'S CONCEPTION OF A TEST POSITION. (This is item 34, Figure 4.)

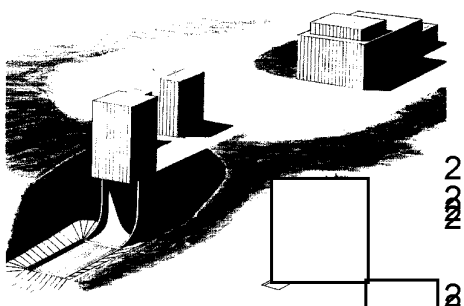


FIGURE 10. ARTIST'S CONCEPTION OF TEST STAND NO 4.

tion of this type could be used to test turbopumps, injector heads, and various component parts in conjunction with a heavy duty engine mounted at a 45-degree angle to the vertical. An assembly/checkout building (item 39) serves both positions of Test Stand No 3, and a control building (item 41) is located adjacent to Test Stand No 3.

TEST STAND NO 4

Test Stand No 4 (item 78) is a relatively small single-position stand for testing liquid propellant rocket engines. An artist's conception and dimensions of this stand are presented on Figure 10. A small support building is located to the rear of this stand, possibly containing vertical pressure tanks. Tanks of this type could be used to store gaseous nitrogen for purging propellant lines prior to propellant loading and engine testing. An assembly/checkout building (item 77) is located southwest of the test stand.

HORIZONTAL TEST BUILDING

A horizontal test building (item 80) is located adjacent to Test Stand No 1. An artist's conception and dimensions of this building are presented on Figure 11. Similar test buildings are located at the Dnepropetrovsk Missile Development and Production Center, the Moskva Missile and Space Propulsion Development Center Khimki 456, and the Voronezh Rocket Engine Test Facility. 2,3/ Engine component, small engine, and possible liquid propellant experimentation tests can be performed in a test building of this type. At least 5 tall, thin stacks are located at the rear of the test building.

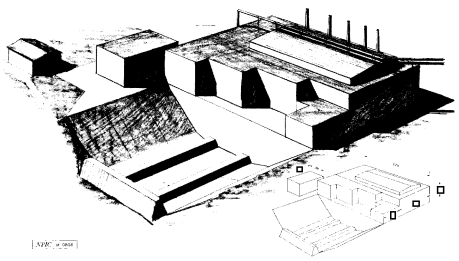


FIGURE 11. ARTIST'S CONCEPTION OF A HORIZONTAL TEST BUILDING. (This is item 80, Figure 4.)

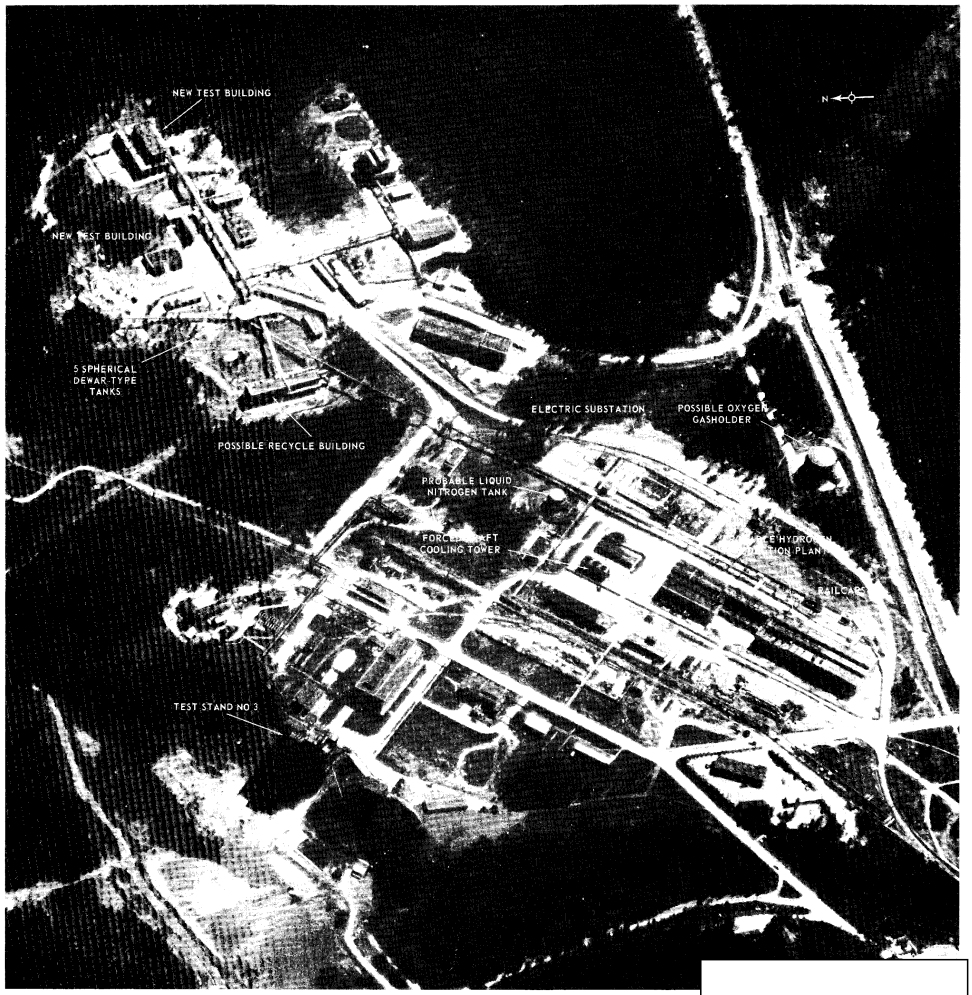


FIGURE 12. NEW TEST AREA AND PROBABLE HYDROGEN PRODUCTION PLANT,

These are probably used to vent the building in the event that toxic fumes accumulate or a propellant spill takes place. Various support and service buildings are located to the rear of this horizontal test building.

NEW TEST AREA

Photography obtained revealed construction activity and some fresh ground scars in the northeast portion of the Zagorsk test facility (Figure 12). The good interpretability of the photography obtained in made possible the identification of 2 new test buildings under construction (items 9 and 19, Figure 4) in the new area. One of the new test buildings (item 19) is unusual in that it has 2 trough-shaped deflectors extending from its northeast side. A test building of this type is capable of testing small liquid propellant rocket engines, or possibly component parts of engines. An artist's conception and dimensions of this test building are presented on Figure 13. The second new test building (item 9) is somewhat larger than the other and is located at the extreme eastern side of the test facility. An artist's conception and dimensions of this building are presented on Figure 14. It is apparently designed to test in a horizontal mode and will probably have an altitude simulation capability when complete. The reason for this interpretation is the presence of a large cylindrical object positioned on the concrete pad on the north side of the test building. This object may eventually be installed as a diffuser tube to create an altitude simulation effect. Upper-stage engines in missile systems are tested in such an environment to simulate the vacuum they encounter in outer space. The presence of these facilities indicates that this new test area will probably be used for the testing of upper-stage rocket engines.

Several additional structures of some interest were also constructed during the time period from Among these are several support buildings utilized as test support or service buildings, a tower/stack, and a row of 5 spherical tanks, which were subsequently enclosed within a building (item 14). Most of the above-mentioned structures are interconnected by pipelines to the Probable Liquid Hydrogen Plant (item 30).

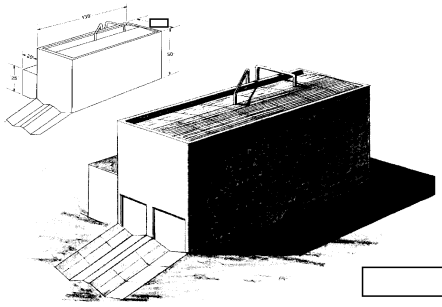


FIGURE 13. ARTIST'S CONCEPTION OF A TEST BUILDING IN THE NEW TEST AREA. (This is item 19, Figure 4.)

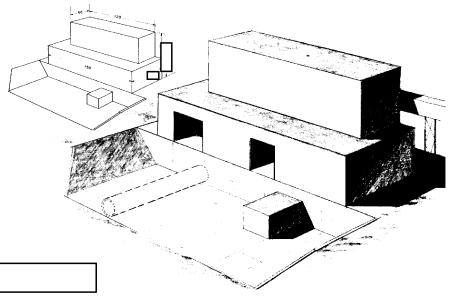
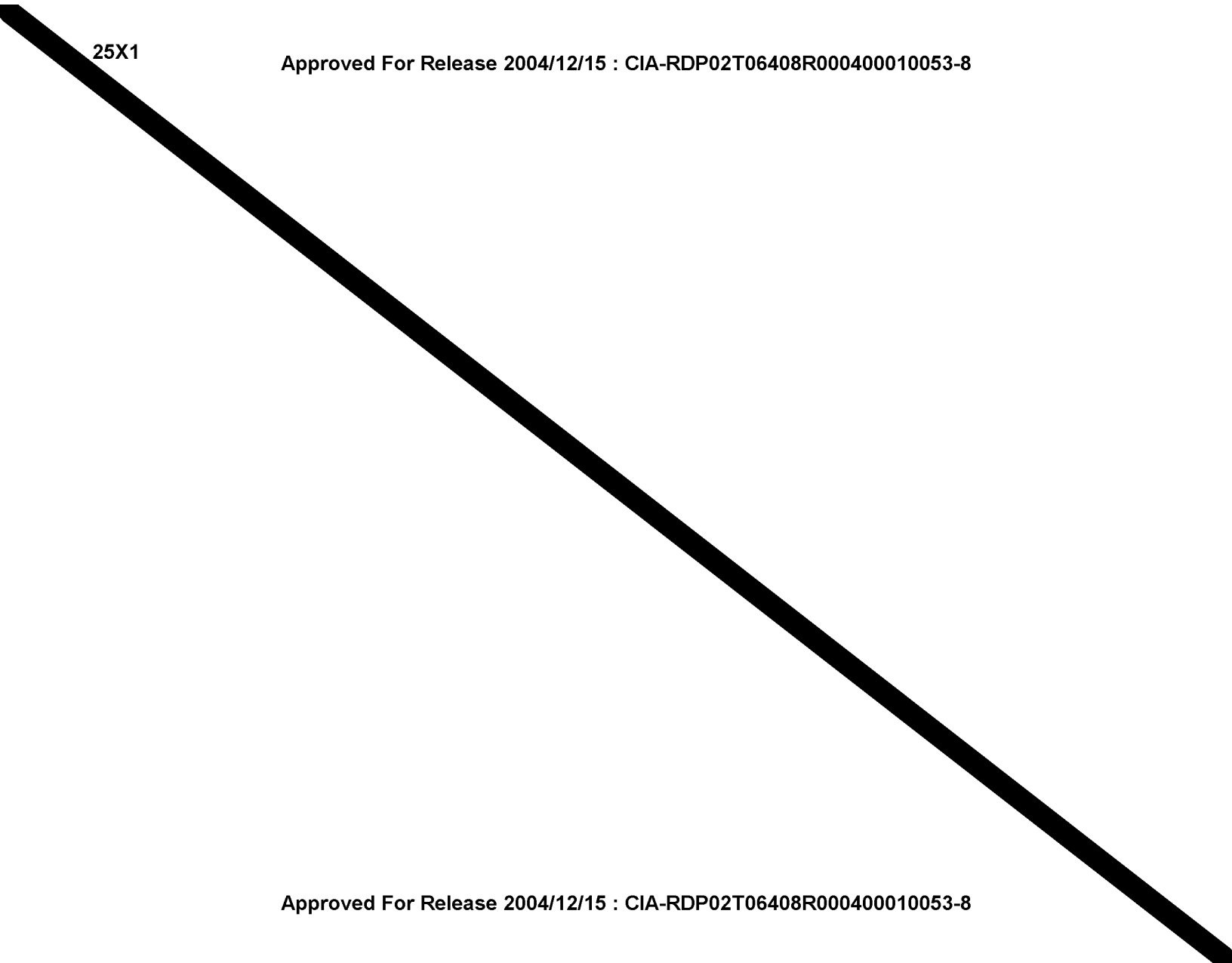


FIGURE 14. ARTIST'S CONCEPTION OF A NEW HORIZONTAL TEST BUILDING. (This is item 9, Figure 4.)

PROBABLE LIQUID HYDROGEN PLANT

photography revealed the construction of a large new building (item 30) and several support structures southeast of Test Stand No 3 (Figure 12). At that time, item 30 consisted of a central section this building had been expanded to a length of 640 feet and appeared to be complete. The central section is separately secured by a low wall. Several items are of considerable significance in the analysis of this facility (item 30) as a Probable Liquid Hydrogen Production Plant. Located in close proximity to this plant is a large electric substation, a large gasholder (item 21), a cryogenic storage tank (item 23), and a triple-column forced-draft cooling tower (item 26). The Probable Liquid Hydrogen Production Plant is connected by pipeline to the building (item 14) that houses the 5 identical spherical tanks mentioned in the proceeding section of this report. The pipeline connection is probably for logistical support as opposed to pipeline transfer of propellant. The actual propellant transfer from the Probable Liquid Hydrogen Production Plant to the 5 spherical storage tanks is probably accomplished by the use of roadable dewar tank trucks.

The most likely method used for producing hydrogen at this plant is the electrolysis of a slightly alkaline solution of water. Hydrogen gas collects at the cathode while oxygen gas collects at the anode. The electrolysis would take place in the Probable Hydrogen Production Plant, power being supplied by the nearby substation. Gaseous oxygen could be stored in the adjacent gasholder (item 21) which has a storage capacity of 370,000 cubic feet. The gaseous hydrogen could be liquefied by utilizing the Joule-Thompson effect (absorption of heat during expansion of a gas). Liquid nitrogen (produced at the air liquefaction plant, item 66, and probably stored in the cryogen storage tank, item 23) could be used as the coolant in this process. The probable end product, liquid hydrogen, would probable be stored in the 5 spherical storage tanks enclosed in a building (item 14). After considering the chronological development of both the Probable Liquid Hydrogen Production Plant and the New Test Area along with the pipeline connection between the two, it appears reasonable to assume that the two are related and that the plant serves the test area.



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REFERENCES (Continued)

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MAPS OR CHARTS

ACIC series, scale 1:200,000

DOCUMENTS

1. NPIC. [redacted] *Pei-ching Guided Missile Development and Production Center, Chang-hsin-tien, China,* [redacted] Jan 67 (TOP SECRET [redacted] 25X1
2. NPIC [redacted] *Dnepropetrovsk Missile Development and Production Center, Dnepropetrovsk, USSR,* [redacted] Jun 66 (TOP SECRET [redacted] 25X1
3. NPIC. [redacted] *Comparison of Large Liquid Propellant Rocket Engine Test Facilities in the USSR,* Feb 67 (TOP SECRET [redacted] 25X1

REQUIREMENT

CIA. C-DI5-82,973

NPIC PROJECT

11212/66 (partial answer)

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